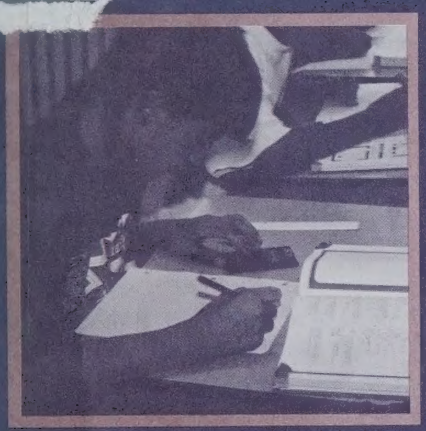
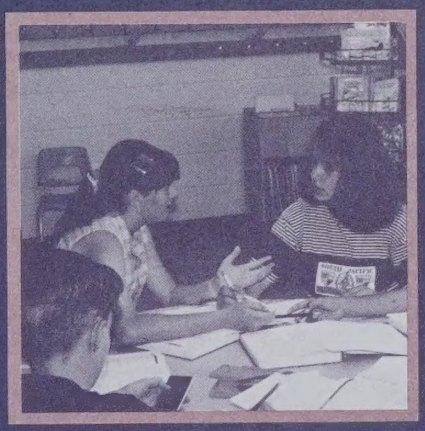
Mathematics

Grade 8

A REPORT CARD FOR ONTARIO





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PROVINCIAL REVIEWS

MATHEMATICS

Mathematics

Grade 8

Sample Questions From the Review

Selected questions from the Grade 8 mathematics review are reproduced below. Two boxes appear under each question. The left-hand box contains the percentage of students who answered the question correctly. The right-hand box contains the percentage of teachers who indicated that students had had the opportunity to learn the material or acquire the skills needed to answer the question. The opportunity-to-learn figures are not available for questions 13 to 15, inclusive.

The panel rating of students' performance is also given for each question.

1. Calculate $18 - 4.87$.

a) 4.69 c) 14.13
b) 13.13 d) 14.23

63	99

Panel rating: marginal

This question involves subtraction of decimal numbers.

2. The expression $2 \times 2 \times 2 \times 3 \times 3$ is equal to:

a) $6 + 9$ c) 12
b) $3 \times 2 \times 2 \times 3$ d) $2^3 \times 3^2$

95	100

Panel rating: superior

This question measures the students' understanding of exponential notation.

3. Calculate $4 - \frac{2}{3}$.

a) $4\frac{2}{3}$ c) $3\frac{1}{3}$
b) $4\frac{1}{3}$ d) $\frac{2}{3}$

70	98

Panel rating: satisfactory

This question involves subtraction of fractions.

Introduction

Provincial reviews form part of the Ministry of Education's ongoing commitment to the monitoring of school programs. The results serve to inform the public about the performance of the educational system in Ontario and to assist schools, school boards, and the Ministry of Education in improving teaching methods and raising the level of student achievement.

A provincial review of mathematics was conducted in selected Grade 8 classes in Ontario during the spring of 1990. The main questions answered by the review were "How well are Grade 8 students achieving the goals of the mathematics curriculum?" and "How are Grade 8 students taught mathematics?" Highlights of the results are listed below.

Highlights

- Grade 8 students are achieving at levels judged to be satisfactory or better in more than half of the topics in the mathematics program; achievement was rated strong in three topics, satisfactory to strong in one topic, satisfactory in five topics, marginal to satisfactory in one topic, marginal in five topics, and weak in two topics.
- Student achievement is strong in organization and representation of data, three-dimensional geometry, and applications involving the use of calculators.
- Student achievement is satisfactory in the following areas: whole numbers and decimals; factors, powers, and square roots; ratio and rate; variables, formulas, and equations; properties of plane figures; and hands-on tasks.
- The following were identified as areas of weakness: fractions, per cent, integers, measurement, geometric constructions, geometric transformations, process problems, and mental computation.
- Achievement levels are slightly higher for male students than for female students.
- Student achievement was higher in 1990 than it was in 1981 on a set of identical questions.
- Most of the students say they believe that mathematics is important for employment, is helpful to them outside school, and is equally important for boys and girls. More than two-thirds of the students say they like mathematics.
- The most commonly used methods for teaching Grade 8 mathematics are presentation of information to the class by chalkboard or overhead projector and assignment of individual work.
- Sixty-seven per cent of the teachers say that their students have access to computers for mathematics; 86 per cent of the students say that they never use computers in mathematics class.
- Seventy-two per cent of the students do at least half an hour of mathematics homework per week, and, of these students, 26 per cent do more than one hour of mathematics homework per week. Five per cent of the students do no mathematics homework. Fifty-three per cent receive help with mathematics from someone at home.

How was the review conducted?

Information was collected from students, teachers, and principals by means of questionnaires and mathematics test questions. The data in this report card are based on a provincial sample of English-language schools (4949 students and 197 teachers). In addition, 57 boards chose to have all their English-language schools administer the instruments so that they could receive summary data at the board and school levels.

A detailed presentation of the results of the provincial review is contained in *A Report for Educators*. Participating schools and school boards have received reports containing local results. A provincial review was also conducted in French-language schools, and parallel reports are available in French.

4. Nunzio received a mark of 20 out of 80 on a science test. What per cent did he receive on the test?

a) 40 % c) 20 %
b) 25 % d) 4 %

57 97

Panel rating: weak

This question requires the students to calculate a per cent.

5. Which of these integers is greater than -3?

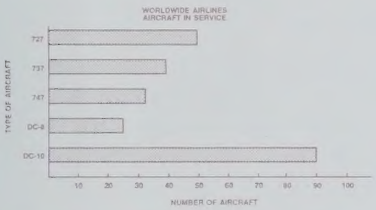
a) 0 c) -6
b) -4 d) -10

94 77

Panel rating: superior

This question measures the students' knowledge of the relative magnitudes of integers.

6. The graph below shows the number of aircraft for Worldwide Airlines.



The total number of aircraft Worldwide Airlines has in service is about:

a) 235 c) 265
b) 250 d) 280

78 90

Panel rating: satisfactory

This question measures the students' ability to read information from a bar graph.

7. What is the value of p in $\frac{p}{2} + 5 = 9$?

a) 4 c) 8
b) 7 d) 14

55 78

Panel rating: marginal

This question requires the students to solve an equation with one variable.

What types of questions were students asked?

Most of the questions in the student booklets were multiple-choice questions, to which students responded by choosing the correct answer from four or five possible responses. Some questions required a written response, such as a numerical answer, a geometric construction, a diagram, or a complete solution to a problem. The students were not permitted to use calculators for the main section of the review. A small number of questions was added to measure students' ability to use calculators. Students were also given twenty mental-computation questions; these were presented orally, with only the numbers given visually, and students were not permitted to use paper and pencil to perform the calculations. In addition, teachers observed student performance on a set of practical tasks requiring the manipulation of materials.

The assessment questions covered the following components of the mathematics curriculum:

1. Numerical methods and algebra:
- understanding place value; doing calculations, making estimations, and solving problems involving whole numbers and decimals
- determining factors and square roots and using exponential notation
- doing calculations that involve fractions and mixed numbers; converting fractions and mixed numbers to decimals
- understanding ratio and rate and using them in simple applications
- calculating per cents and using per cents in practical problems
- locating integers on a number line and ordered pairs in the plane; adding and subtracting positive and negative integers
- organizing and representing data in pictographs, bar graphs, broken-line graphs, and circle graphs
- performing algebraic manipulations involving variables, formulas, and equations

2. Measurement and geometry:
- determining perimeter, circumference, area, and volume and using metric units
- making geometric constructions
- identifying properties of plane figures and applying properties in numerical calculations
- recognizing and sketching three-dimensional objects
- identifying and drawing the images of figures under transformations; using and making scale drawings

3. Process problems:
- applying problem-solving strategies to unfamiliar problems

4. Calculator skills:
- using calculators to perform selected computations and applications

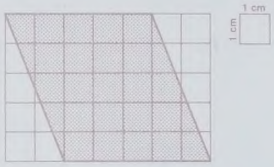
5. Mental computation:
- performing calculations without the aid of pencil and paper

6. Hands-on tasks:
- performing tasks requiring the manipulation of materials (assessed through teacher observations)

The questions were designed to assess abilities at three cognitive levels: recognition or recall, comprehension, and application. Recognition or recall required the student to recognize or recall a definition, concept, formula, or algorithm. Students demonstrated comprehension by using a concept or algorithm in a routine way requiring little analysis. Application questions required using a concept, formula, or algorithm in problems involving some analysis, or solving non-routine problems that required the choice of a strategy as well as analysis.

Selected questions from the assessment booklets are presented in the margins of this report card. The answers to these questions are also given.

8. Each small square below has an area of 1 cm^2.



What is the area of the shaded parallelogram in the above diagram?

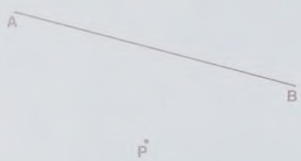
a) 12.5 cm^2 c) 25 cm^2
b) 20 cm^2 d) 30 cm^2

83 88

Panel rating: strong

This question measures the students' ability to calculate the area of a parallelogram.

9. Construct a line through P perpendicular to AB.

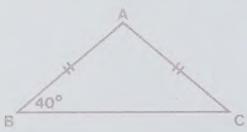


43 66

Panel rating: weak

This question requires the students to construct a perpendicular line through a given point, using a method of their choice.

10. Triangle ABC is an isosceles triangle. The measure of ∠B is given.



What is the measure of ∠A?

a) 60° c) 100°
b) 90° d) 140°

70 81

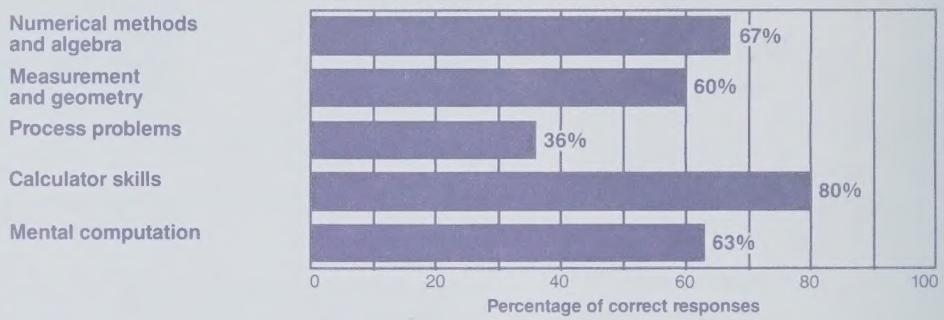
Panel rating: satisfactory

This question measures the students' understanding of the properties of an isosceles triangle.

How well did students perform?

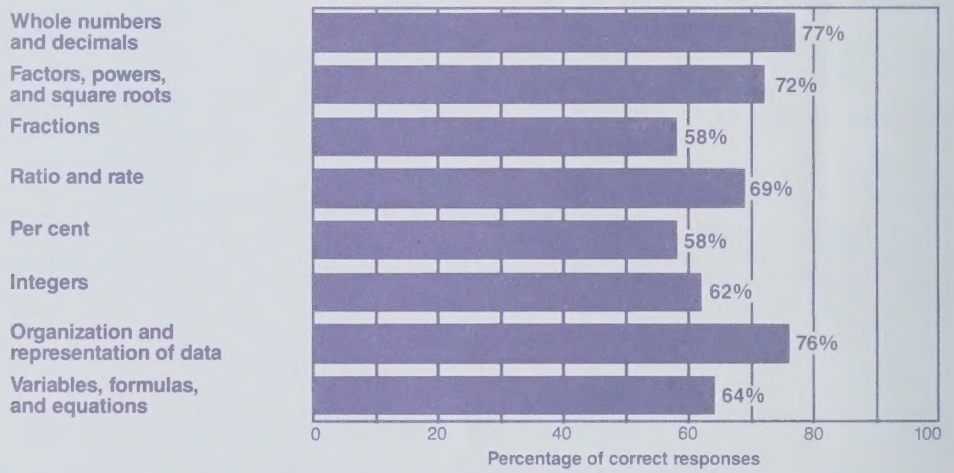
The average percentages of correct responses to questions in the main areas of the Grade 8 mathematics curriculum are presented in the following graph. An average percentage correct was not computed for the hands-on tasks assessed through teacher observations.

Summary of Student Achievement in Mathematics

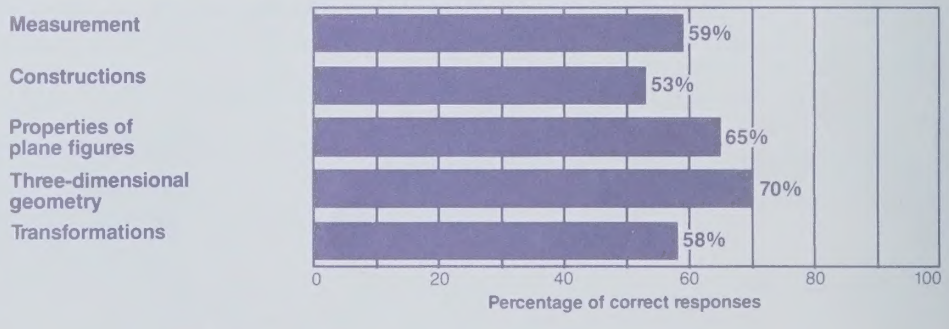


The graphs that follow show the percentages of correct responses for the specific topics within numerical methods and algebra, and within measurement and geometry.

Student Achievement in Numerical Methods and Algebra by Topic



Student Achievement in Measurement and Geometry by Topic



11. Complete the drawing of the rectangular prism below.

89 51

Panel rating: strong

This question requires the students to complete the design of a three-dimensional object.

12. Peter and Juanita decided to start saving money. Peter can save 3 dollars each month and Juanita can save 5 dollars each month. At this rate, after how many months will Juanita have exactly 10 dollars more than Peter?

61 88

Panel rating: satisfactory

This process problem requires the students to choose an appropriate strategy to find the combination of numbers that satisfies the specified conditions.

13. The distance on a map measures 6.4 cm. The actual distance is 2 688 km. On the scale used, 1 cm represents:

a) 42 km c) 1 720 km
b) 420 km d) 17 203.2 km

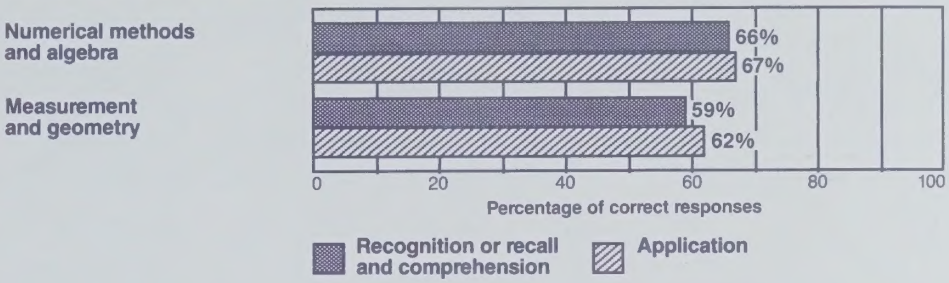
78

Panel rating: strong

Students were allowed to use their calculators to answer this question on ratio.

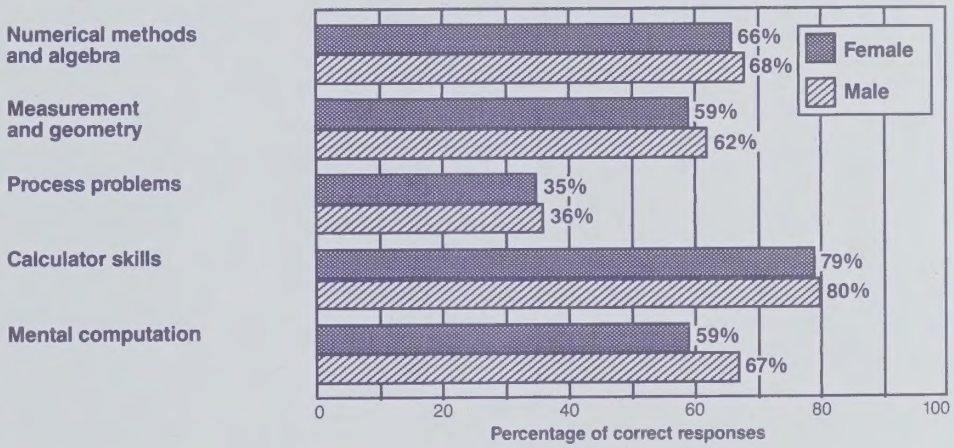
The following graph shows student achievement by cognitive level. Note that two of the cognitive abilities (recognition or recall and comprehension) were combined for this analysis. A breakdown by cognitive level was not computed for process problems because they are all application questions.

Student Achievement by Cognitive Level



As shown in the following graph, achievement levels are slightly higher for male students than for female students. As would be expected at the Grade 8 level, the enrolment is 50 per cent male and 50 per cent female.

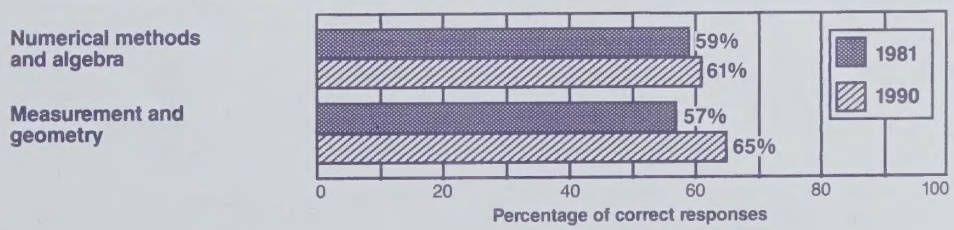
Student Achievement by Gender



Comparison with achievement in 1981

Forty questions that were answered by Ontario students in 1981 as part of the Second International Mathematics Study were included in the current provincial review. As shown in the following graph, students scored considerably higher in 1990 than in 1981 on questions in measurement and geometry. Achievement was slightly higher in 1990 for numerical methods and algebra.

Achievement Scores in 1981 and 1990



Interpretation panels composed of educators, parents, and trustees reviewed the test questions and the student results. Prior to seeing any student results, panel members established a standard for each question in the form of an expectation for student performance. Actual student achievement was then rated against these standards. Results were rated on a five-point scale: *superior, strong, satisfactory, marginal,* or *weak*. The panel ratings for the main curriculum areas and the

14. What is the sales tax on a $200 purchase if the rate of sales tax is 8%?

58

Panel rating: marginal

This question was presented to the students orally, with only the numbers shown. Students were required to do the calculation mentally, without the aid of pencil and paper.

15. Construct a circle graph, using a protractor, compasses, ruler, and calculator.

53

Panel rating: satisfactory

This was one of several tasks that teachers watched students perform. Students were required to construct the sections of the circle graph correctly.

specific topics are given below. For two of the topics, the panel was unable to specify a single rating. On these topics, about half of the questions received one rating and half another, so that overall performance was judged to be between the two levels.

1. Numerical methods and algebra	***– satisfactory***
■ whole numbers and decimals	*– satisfactory/strong*
■ factors, powers, and square roots	*– satisfactory*
■ fractions	*– weak*
■ ratio and rate	*– satisfactory*
■ per cent	*– marginal*
■ integers	*– marginal*
■ organization and representation of data	*– strong*
■ variables, formulas, and equations	*– satisfactory*
2. Measurement and geometry	***– satisfactory***
■ measurement	*– marginal*
■ constructions	*– marginal*
■ properties of plane figures	*– satisfactory*
■ three-dimensional geometry	*– strong*
■ transformations	*– marginal/satisfactory*
3. Process problems	***– weak***
4. Calculator skills	***– strong***
5. Mental computation	***– marginal***
6. Hands-on tasks	***– satisfactory***

As shown by the panel ratings, student achievement is strongest in organization and representation of data, three-dimensional geometry, and calculator skills. Some weaknesses are evident in fractions, per cent, integers, measurement, constructions, transformations, process problems, and mental computation.

How do students feel about mathematics?

Sixty-seven per cent of the students say they like mathematics, 63 per cent say they are good in mathematics, and 20 per cent say that mathematics is difficult. Ninety-four per cent of the students consider mathematics to be important for employment, 84 per cent say that mathematics helps them outside school, and 96 per cent say that mathematics is equally important for boys and girls.

How will the results of the review be used?

The provincial results have been provided to the committees currently working on the formulation of benchmarks and the restructuring of education in Ontario. This detailed information will assist the committees in their specification of instructional strategies and selection of resources. Steps will be taken to reinforce the positive aspects of the mathematics program that have been identified and to ensure that procedures are implemented to strengthen weak areas. Improvements in the mathematics program will be achieved through the following activities, which are part of the ministry's action plan:

- a review of the mathematics curriculum guideline, to determine what changes should be made
- an examination of needs in the area of resource development
- the identification of needs in the area of teacher in-service

The schools and school boards involved in the review have been provided with their own results and will interpret them and make recommendations for program improvement. School boards will develop local action plans based on a complete study of their data. Action at the board level should include the following:

- a review of local policy and program documents
- an assessment of implications for staff development
- an examination of needs in the area of development of local resource materials
- preparation of a report, to be submitted to the Ministry of Education, on the actions that have been taken and that are planned

Answers to Questions:

1. b
2. d
3. c
4. b
5. a
6. a
7. c
8. c
9.

10. c
11.
12. 5 months
13. b
14. $16

Min Gu Ontario. Ministry of
510.76 Education.
O59ma Mathematics, grade 8
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ISBN 0-7729-8953-2
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